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COMPUTERS
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Vol. 2, No. 3 April, 1953

The Art of Solving Secret Ciphers, and the Digital Computer

Fletcher Pratt

Avenues for Future Development in Computing Machinery

Edmund C. Berkeley

Hungarian Prelude to Automation

Gene J. Hegedus

Roster of Organizations (cumulative)

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THE EDITOR'S OFFICE

Forthcoming Articles. Among the articles which we hope to publish before long are: one on the new IBM 701 automatic computer, by Dr. Cuthburt C. Hurd, of International Business Machines Corp.; one by Dr. Grace M. Hopper of Remington Rand, on compiling routines, i.e. routines by means of which an automatic computer can construct its own program; an article by John Diebold, author of "Automation", on automation of a stock exchange; and an article by James Moran, vice president of Barkley and Dexter, on some novel applications of automatic processes.

If any of our readers has something worth saying about some not-too-technical topic in the field of computers and automation, we should like to hear from him.

Manuscripts. We desire to publish articles that are factual, useful, understandable, and interesting to many kinds of people engaged in one part or another of the field of computers and automation. In this audience are many people who have expert knowledge of some part of the field, but who are laymen in other parts of it. Consequently, a writer should seek to explain his subject, and show its context and significance. He should define unfamiliar terms or use them in a way that makes their meaning unmistakable. He should identify unfamiliar persons with a few words. He should use examples, comparisons, analogies, etc., whenever they may help readers to understand a difficult point. He should give data supporting his argument and evidence for his assertions. An article may certainly be controversial if the subject is discussed reasonably.

Ordinarily, the length should be 1000 to 4000 words, and payment will be $10 to $50 on acceptance. A suggestion for an article should be submitted to us before too much work is done. To be considered for any particular issue, the manuscript should be in our hands by the 20th of the preceding month.

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THE ART OF SOLVING SECRET CIPHERS, AND THE DIGITAL COMPUTER

by Fletcher Pratt
Author of "Ordeal by Fire" and thirty other books

There are perhaps few areas where the use of digital computers is so obviously desirable as the area of <u>cryptanalysis</u>, the reading of an unknown message in cipher. The vast bread-and-butter bulk of deciphering work consists of arduous, painstaking drudgery — counting the frequencies of letters, the lineal distance between reappearances of the same letter, the frequency of and distances between bigrams like TH, trigrams like ING, and other groups of letters, the numerical distance in the alphabet between adjoining letters in the message, and so on. In fact, this drudgery must be largely complete before the solution of the cipher can even begin; upon it depends the correct identification of the type of cipher being dealt with, for the methods of solution for various types of ciphers are quite different. The lightning speed and accuracy with which computers can carry out processes formerly requiring many clerks and much time have caused computing machinery to become the cryptanalyst's greatest aid.

Fundamentally, there are five basic types of ciphers. Here we exclude codes, in which phrases or whole sentences are represented by completely arbitrary groups of letters, and a special code book is required to read the message. The cipher types are known as transposition, simple substitution, double substitution, syllabic ciphers and polygram substitutions. In all of these types except syllabics, which approach code, one letter of the ciphered text represents a single letter of the clear, except to the extent that "nulls", meaningless letters, are inserted to delay the process of decipherment. It may be added that nulls are seldom inserted except in transposition ciphers because they are apt to delay the deciphering process so thoroughly that not even the intended recipient of the message can read it.

Transposition

A "transposition cipher" is one in which the letters of the clear text are disarranged according to a preconceived plan. For example, we write the text "There is another aspect to the question at present" as follows, adding nulls to fill out the pattern:

```
T H E R E   Q U E S T
I S A N O   I O N A T
T H E R A   P R E S E        (1)
S P E C T   N T X J M
T O T H E   B W C Q K
```

Then we may use the formula 3-5-4-2-1 to disarrange the resulting columns:

```
E E R H T   E T S U Q
A O N S I   N T A O I
E A R H T   E E S R P        (2)
E T C P S   X M J T N
T E H O T   C K Q W B
```

Then we apply the same formula to disarrange the lines, and the message is written off as:

EARHT TEHOT ETCPS AONSI EERHT EESRP CKQWB XMJTN NTAOI ETSUQ

(3)

There are various methods of complicating the business, such as writing off the letters by diagonals. If this were done with the grouping produced by (2) the result would be:

THIRS TENHS EORPT AACOE THEET QUISO PTARN ETSTB NEJWE MQXCK

(4)

and the easily recognizable groupings would be broken up. Tableaux of 6 x 6 letters may be used, or 6 x 4, or irregular shape.

Deciphering

The methods of decipherment are as numerous and intricate as those of trying to prevent it, but they all come down to the same thing: the matching up of pairs or chains of letters to form valid combinations, followed by the establishment of a pattern of mathematical relationship in the order of the letters. Thus given (2) or (3) a cryptanalyst would be immediately attracted by the presence of the HT combinations. He would try reversing the order of these two letters, since TH is the most common trigram in English. On applying the order of letters thus established to the other groups, he would find that the diagnosis was accurate. He would find deciphering more difficult with (4) because letters adjacent in the clear are now separated by varying intervals, but the variations form a regular pattern, and after some trial and error the pattern becomes recognizable.

The basis of this solution is the comparison of groupings formed by matching up pairs of letters in the message with the frequency tables for bigrams and trigrams. There seems no reason why a digital computer could not do the job if it were properly programmed by translating the letters into machine language and storing the bigram and trigram tables in its memory. Indeed, the computer ought to improve on the performance of a human cryptanalyst, since the process is one of matching up sets of letters from various parts of the message having mathematical relations with each other. For that matter, if you are going to put the computer into the business of analyzing cryptograms, there is no reason why it should not be supplied with the right kind of tables in several languages, and be instructed to perform in a single analytical operation examinations that now require the services of a staff.

Simple Substitution

Handling simple substitution ciphers is so easy for even quite amateur cryptanalysts that it is no use bothering a machine with them. The basic type, called the "Julius Caesar" for the not-very-odd reason that it was invented by that noble Roman, consists in substituting for each letter the letter two (or three, etc.) places farther along in the alphabet; thus if A becomes C, B becomes D, and so on. That is, each letter of the clear is represented by one and always the same letter or character of the enciphered text. This type is so simple that when we apply letter-frequency tables or pattern-words (like BEGINNING, with its pattern of .... ABCCBCA) such ciphers are used as puzzles for children.

This simplicity early became clear to cryptographers; so they invented the "suppression of frequencies", which means that additional characters, usually figures, are added to the alphabet and several of them are used to represent the more frequent letters, such as E and T. This type also is fairly easy for cryptanalysts

without the help of computers. The pattern-word method again is valid; so is the method of trial and error with various combinations ("What if 11, 17 and 26 all represent E?") and there is also a line of attack through identifying letters like J, K, X, Q and Z, whose very low frequency cannot be concealed.

Syllabics

However, ciphers based on suppression of frequency have developed into the syllabics, and these are a very much more serious matter. The most famous, known as the great Rossignol cipher of Louis XIV, contained over 600 different numbers. Some of them stood for single letters, some for combinations of letters and some for entire words. Thus the word THE might be indicated by the figures 316-29-472, one for each letter, or 18-281 for TH and E, or 109-500 for T and HE, or simply by 456 for THE as a group. Despite a vast accumulation of material, it took Col. Bazèries, one of the great cryptographers of history, many years to break down the Rossignol, and he achieved it chiefly because the encipherers got lazy and fell into the habit of not using alternates often enough.

The main problem in breaking a syllabic cipher is that of determining whether a given character represents one, two or more letters of the clear. This is a hard problem, even for a computer, and would probably have to be approached indirectly and with a considerable amount of material. (Bazèries had all the records of the court of Louis XIV to work on with the Rossignol.) A knowledge of the probable subject of the message would be helpful; for example, if military, such a pattern-word as BATTALION would offer a point of attack. The computer would be programmed to find "unfavorable" areas in the message where such a word could not occur, then investigate the favorable areas with this and other probable words, and so by elimination reach a section of the message with several probable words, working from there to possible identities. This was, in essence, the method of Bazèries; the process took a long time because he lacked a computer, but the man with one available could probably count on the cryptographer who enciphered a message making the same mistake about insufficient alternates that the operators of the Rossignol did. It is almost impossible for a cryptographer to remember exactly how he enciphered something three weeks before.

Double Substitutions

In actual use, double substitutions represent by far the largest family of ciphers. Many of the enciphering machines which exist are fundamentally devices for producing enormously complex double substitutions. The simplest form, known as the Vigenère, is usually written with a device called the St. Cyr ruler, a ruler with a slide having one alphabet on the fixed portion, and another alphabet sliding below it. The cipher is written by means of a key-word understood between the parties. First, the message is written down with the key-word above it, repeated and repeated. Then the first letter of the key-word on the slide is brought beneath A of the fixed alphabet. For example, with the same message as before and the key-word STAIN, let us demonstrate. The slide, in its first position to use S of the key-word, looks like this:

```
Fixed:              ABCDEFGHIJKLMNOPQRSTUVWXYZ
Slide:          ....PQRSTUVWXYZABCDEFGHIJKLMNOPQRSTU....
```

With this setting, we substitute for the first letter T of the clear that letter which appears below it on the slide, L. The process continues:

Key-word: STAIN ST AINSTAI NSTAIN ST AIN STAINSTA IN STAINST
Clear: THERE IS ANOTHER ASPECT TO THE QUESTION AT PRESENT (5)
Message: LAEZR AL AVBLAEZ NKIEKG LH TPR INEAGAHN IG HKEARFM

The message is then written in five-letter groups to prevent identification of words as such.

The frequencies are now completely disturbed; E in the clear is now represented by two different letters E, R, in the message, and A in the message represents three different letters A, H, S of the clear. However we note that the THER of THERE and the THER of ANOTHER both happened to fall under the same portions of the key-word and were enciphered with identical letter groups, and the same thing happened with the ES combinations in QUESTION and PRESENT. Such repetitions are used to break down the cipher by what is known as the Kasiski method. The cryptanalyst counts from one repeated group to another, in both these cases getting the figure 10, then factors the result (2 x 5) to determine the probable length of the key-word whose appearance over identical letter groups has brought about these repetitions. (In a long message there will be some accidentals, but a very high percentage of genuine repetitions.) By taking every fifth letter, he then has a group of five simple substitution ciphers in which each letter of the clear is represented by one and always the same letter of the cipher, and which can be broken down by means of frequency tables. Not quite as easily as with simple substitution, because the letters are discontinuous and pattern-words are of little use, but it can be done. It would seem fairly easy to program a computer to perform all these steps at great speed, and although in practical cryptanalysis the usual line of attack is to recover the key-word first, it could easily be left until the decipherment of the message.

Cryptographers became aware of this Kasiski deciphering method in the middle of the last century, and they introduced a whole series of methods for defeating it. The methods included: the "autoclave" ciphers, those that only start with a key-word, then use the text of the cipher itself as a key:

Key-word: STAIN TH EREISAN .....
Clear: THERE IS ANOTHER ..... (6)
Message: LAEZR BZ EESBZEE .....

giving a key-word of infinite length; the use of St. Cyr rulers with disarranged alphabets; and the employment of key-words that themselves change with each repetition. As an example of the last, if STAIN were to be used as a shifting key with a period of 1, each key-word letter would move along one place in the alphabet at each repetition, thus making the key-word TUBJO on its second appearance, UVCKP on its third, and so on. Such a shifting key, used with a jumbled alphabet on the slide will clearly defeat the Kasiski method.

Most of the enciphering machines built for and used by governments add still further complications; a typical machine made by a Swedish firm has several discs bearing different disturbed alphabets, and shifts from disc to disc for encipherment automatically according to a code punched into the machine.

Deciphering

All such ciphers, however, are ultimately susceptible to computer analysis, because the alphabet itself is periodic, a circle with A following Z, not a straight line. Observe that IS enciphered with TH in (6) above comes out as BZ, and so does TH enciphered with the key-letters IS. A count on the intervals between the repetitions of a given letter-group, or even a single letter, the type of count a computer is

best adapted to taking, will by factoring yield a predominating interval, just as it did in the Kasiski method with (5). This interval will be the "period" or length of the original key in an autoclave. (It seems unnecessary to labor the adaptability of computers for such counts.) Suppose a period of 5 is found; the cryptanalyst sets down his message in 5 columns, through which there will be a regular progression as S enciphered T in (6), T enciphered I, and I another T. He then makes the assumption that the first letter of the key-word was A and on that assumption deciphers the entire column. The same assumption will then be made for B, and so on through the alphabet. One of these assumptions is correct; which one can usually be determined with very little examination, since the unfavorable columns will contain a high number of rare consonants. These progressive decipherments and even the determinations could readily be handled by a computer.

Shifting keys and jumbled alphabets may also be handled by essentially mathematical methods. Other methods not succeeding, the cryptanalyst counts the alphabetic distances between adjoining pairs of letters in the message. Let us say he has a message beginning BKCM. The distance between B and K in the alphabet is 9; so is that between C and M, while the distance between K and C (around the end of the alphabet) is 18. He writes his message down showing the alphabetic interval between successive letters:

```
B   K   C   M
  9  18   9
```

Farther on in the message he encounters, we suppose, the sequence ZIAJ, which also has 9-18-9 as its alphabetic distance sequence. There is a high probability that in spite of the different letters used that these groups represent the encipherment of at least three identical contiguous letters of the clear. Not letters with these precise intervals, because of the jumbling of the alphabets; but it is impossible to prevent one period from appearing in the message as another period.

His next step is to count the distance from the appearance of BKCM to that of ZIAJ and those between all other repeated numerical sequences, and then factor as in the Kasiski method. This process again yields a period; suppose it is 7. Then he returns to the count of the distance between the appearances of BKCM and ZIAJ; let us suppose that it was 35 letters. It therefore took 5 shifts to turn B into Z, and in addition he has way-stations in the shifting process. The nature of the shifts is now determined. In practical cryptanalysis the usual method is now to re-encipher all but the first period into the cipher represented by the first period, and then treat it as an ordinary Vigenere. Such a process should be easy for a computer.

Polygram Substitutions

Polygram substitutions may be illustrated by the Playfair cipher. A letter tableau is set up, with J suppressed and I pinch-hitting for it when it appears in the message:

```
A B C D E
F G H I K
L M N O P
Q R S T U
V W X Y Z
```

The clear text is now written down divided into pairs of letters. Now these pairs are located in the tableau either in the same line or in the same column or in diagonal relationship to each other. If they are in the same line, the letter follow-

ing each is substituted; if they are in the same column, the letter below each is substituted; and if they are diagonally related, the letters at the corners of the opposite diagonal of the indicated square are substituted. For example,

Clear TH ER EI SA NO TH ER ...
Message SI BU DK QC OP SI BU ... (7)

A doubled letter is broken up by inserting a null, usually X.

Playfairs and other polygram ciphers come in all degrees of complexity. It is usual to disarrange the alphabet in the tableau; another letter may be dropped and a 6 x 4 tableau used; or a letter added to produce a 3 x 9 tableau; the letters may be substituted on some other system. But no matter what the system a polygram substitution is essentially a simple substitution by pairs with a high suppression of frequencies. Observe that using the tableau above, E must always be represented by A, B, C, D, K, P, U or Z and that the repeated TH comes out as SI both times. These facts are used with a table of bigram frequencies to break the cipher, and a computer ought to be able to make the necessary comparisons more rapidly than a human being.

Actual Practice

All this has been made much easier than it is in actual practice, and here only the main lines of attack have been indicated. In fact, there have been double encipherments, including both transposition and substitution, huge periodic numerical ciphers, and ciphers that operate by algebraic methods on a huge tableau. But the difficulty with most such complicated ciphers is that they are of little value in practical use; they fail to meet the dual test of being transmitted with speed and accuracy. A garble mixed up one very important American message during the Battle for Leyte Gulf, but there was a certain amount of poetic justice in this, since the Japanese lost the Battle of Midway because in their anxiety to prevent garbles, they used a cipher that American experts had no difficulty in cracking. Whether the Americans did it with computers or not has not been stated, but there seems very little doubt that digital computers in the last few years have been and in the future will be the main tool of the cryptanalyst. The computer performs the spadework with a speed no human being can rival, and leaves to the cryptanalyst himself the essentially human task of having the brilliant idea that XQKMYI might just possibly stand for REASON, and then programming the computer to tell him whether there is any systematic process which will produce such an encipherment.

ROSTER OF ORGANIZATIONS IN THE FIELD OF COMPUTERS AND AUTOMATION

(Edition 7, cumulative, information as of April 1, 1953)

The purpose of this Roster is to report organizations (all that are known to us) making or developing computing machinery, or components, or data-handling equipment, or equipment for automatic control and materials handling. Each Roster entry when it becomes complete contains: name of the organization, its address, nature of its interest in the field, kinds of activity it engages in, main products in the field, approximate number of employees, year established, and a few comments and current news items. When we do not have complete information, we put down what we have. The term "components" as used here does not include nuts, bolts, resistors, condensers, motors, tubes, mercury, etc., but does include magnetic drums, cores, tapes, and certain other components that have an intimate and significant connection with machinery covered in the Roster.

We seek to make this Roster as useful and informative as possible, and plan to keep it up to date in each issue. We shall be most grateful for any more information, or additions or corrections that any reader is able to send us.

Although we have tried to make the Roster complete and accurate, we assume no liability for any statements expressed or implied.

This edition is a cumulative and up-to-date edition, except that: (1) some organizations previously mentioned have been omitted, either at their request or because their interest in the field is apparently no longer current; and (2) some information no longer news has been omitted.

Abbreviations

The key to the abbreviations follows:

Size
- Ls Large size, over 500 employees
- Ms Medium size, 50 to 500 employees
- Ss Small size, under 50 employees
  (No. in parentheses is approx. no. of employees)

Interests in Computers and Automation
- Dc Digital computing machinery
- Ac Analog computing machinery
- Ic Incidental interests in computing machinery
- Sc Servomechanisms
- Cc Automatic control machinery
- Mc Automatic materials handling machinery

When Established
- Se Organization established a short time ago (1942 or later)
- Me Organization established a "medium" time ago (1923 to 1941)
- Le Long established organization (1922 or earlier)
  (No. in parentheses is year of establishment)

Activities
- Ma Manufacturing activity
- Sa Selling activity
- Ra Research and development
- Ca Consulting
- Ga Government activity
- Pa Problem-solving activity
- Ba Buying activity
  (used also in combinations, as in RMSa, "research, manufacturing and selling activity")

*C This organization has very kindly furnished us with information expressly for the purposes of the Roster, and therefore our report is likely to be more complete and accurate than otherwise might be the case. (C for Checking)

*A This organization has placed an advertisement in this issue of COMPUTERS AND AUTOMATION. For more information, see their advertisement. (A for Advertisement)

ROSTER

Addressograph-Multigraph Corp., 1200 Babbitt Road, Cleveland 17, Ohio, and elsewhere *C
Addressograph plates, prepared automatically from punched tape, which will list and total repetitive figures. Data written at speeds up to 20 lines per second, and as a byproduct codes automatically punched into punch cards. Electronic facsimile printers for high-speed copying of typed data contained in unit card records. Machine functions controlled by sensing and selecting mechanism operated by punched holes in cards. Ls(8000) Le(1893) Ic RMSa

Alden Electronic and Impulse Recording Equipment Co., Alden Research Center, Westboro, Mass. *C, *A
Facsimile recording equipment and facsimile components. Ma SEE Alden Products Co.

Alden Products Co., 117 No. Main St., Brockton, Mass. *C, *A
General and specific components for digital and analog computing machinery; plug-in components, sensing and indicating components, magnetic delay line units, magnetic storage cores, etc. Ms(300) Me(1930) Ic RMSa

Alfax Paper and Engineering Co., Alden Research Center, Westboro, Mass. *C, *A
Electrosensitive recording papers. Ma SEE Alden Products Co.

Allen Calculators, Inc., 678 Front Ave., Grand Rapids, Mich.
Adding machines. Dc RMSa

American Automatic Typewriter Co., 614 North Carpenter St., Chicago 22, Ill. *C
Pneumatically controlled programming and testing devices. Automatic selective typing equipment (Autotypist). Testing machines for typewriters, adding machines, calculating machines. Ms(100) Le(1868) Ic RMSa

Ampex Electric Corp., Redwood City, Calif. *C
Magnetic recording of data. Ms(375) Se(1944) Ic RMSa

ANelex Corporation, Concord, N. H., and 53 State St., Boston 9, Mass. *C
High-speed printer (600 characters per second, numerical). Other input-output devices being developed. Ss Se DIc RMSa

Applied Science Corporation of Princeton, P. O. Box 44, Princeton, N. J. *C
Radio telemetering and automatic data conversion. Devices for automatic and semi-automatic reduction and analysis of telemetering and radar data. Analog read-in and read-out devices. Digital storage and computing elements. MADAM (Multipurpose Automatic Data Analysis Machine). Ms(85) Se(1946) DAc RCPMSa

Argonne National Laboratory, Chicago 18, Ill.
Maker of Oracle and Avidac automatic digital computers. Ms Se DIc RCGPa

Arma Corp., 254 36th St., Brooklyn, N. Y., until Oct. 15, 1952; then Old Country Rd., Garden City, L. I., N. Y. *C
Electronic fire-control apparatus. Analog computer components including resolvers, induction generators, etc. Ls(7700) Le(1918) DASc RMSa

Armour Research Foundation, Illinois Inst. of Technology, 35 West 33 St., Chicago 16, Ill. *C
Magnetic recording. Digital, analog, and data-handling equipment. Servomechanisms. Ls(1000) Me(1936) DASc RCa

Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill. *C
Use analog computers; manufacture servomechanisms and automatic controls. Ms(400) Me(1930) SCc RMSPa

Audio Instrument Company, Inc., 133 West 14 St., New York 11, N. Y. *C, *A
Electronic, mechanical, and optical analog computers. Precision electronic instruments. Fire-control equipment, logarithmic amplifiers. Specialized passive computer which corrects for film non-linearity in photometric work, etc. Designing narrow-band telemeter system, analog/digital and digital/analog converters, special-purpose digital computers, etc. Ss(10) Se(1949) DACSc RCSa

Automatic Electric Co., 1033 W. Van Buren St., Chicago, Ill. *C
Telephone equipment, relays, stepping switches, etc., for independent telephone companies and computing machinery companies. Automatic control components. Ls(6000) Le(1892) ICc RMSa

Avion Instrument Corp., Paramus, N. J. *C
Digital and analog computing machinery. Magnetic recorders, amplifiers, precision wire-wound potentiometers. Ms(175) Se(1946) RMSa DAIc

Baird Associates, 33 University Road, Cambridge 38, Mass. *C
Spectroscopic analysis equipment. Scientific instruments. Analog devices and servomechanisms. Instrumentation for industrial control. Research in physical optics. Ms(170) Me(1936) AISc RMSa

Barber-Colman Co., Rockford, Ill. *C
Automatic controls, textile machinery, machine tools, etc. Barber-Colman-Stibitz digital computer, operating. Ls(3000) Le Dc RMSa

Beckman Instruments Inc., South Pasadena, Calif. *C
"Analog-digital" converter. Special purpose control computers. EASE computer (Electronic Analog Simulating Equipment). Ls(1000) Me(1934) DAc RMSa

Bell Telephone Laboratories, Murray Hill, N. J., and 463 West St., New York, N. Y.
Automatic switching. Bell general purpose relay computers, for government use and their own use. Ls Le Dc Ra

Bendix Aviation Corp., Computer Division, 5630 Arbor Vitae St., Los Angeles 45, Calif. *C
Digital information processing systems for military and industrial use. Digital differential analyzer. Ms(59) Se(1952) DAc RMSa

Bendix Aviation Corp., Pacific Division, North Hollywood, Calif. *C
Telemetering systems. Digital, controls and components. Ms(50) Se(1952) Ic RMSa

Benson-Lehner Corp., 2340 Sawtelle Blvd., West Los Angeles 64, Calif. *C
Automatic and semi-automatic devices (both analog and digital) for computing data analyzing, data reduction, optical measuring, guided missile analysis, etc. Commercial applications of industrial control devices. Ms(65) Se(1950) DAc RCMSa

Edmund C. Berkeley and Associates, 36 West 11 St., New York 11, N. Y., and 19 Milk St., Boston 9, Mass. *C, *A
Small one-of-a-kind computers (Simon) and robots (Squee). Others under development. Courses, publications. Publisher of "Computers and Automation". Ss(11) Se(1948) Dc RCMSa

Birkbeck College, University of London, London, England.
Maker of ARC, APEXC, and SEC digital computers. DAc RCPa

Boeing Airplane Co., Seattle 14, Wash.
BRAC, Boeing Electronic Analog Computer. Servomechanisms and analog computing devices. Ls Le ASc RMSa

British Tabulating Machine Co., Ltd., 17 Park Lane, London W. 1, England *C
Punched card machines. Ls(4500) Le(1908) Dc RCPMSa

Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio
Recording analyzers. Magnetic tape, heads, and drums. Computer components. Ls Le Ic RMSa

Bryant Chucking Grinder, Springfield, Vt.
High-speed spindles, and applications to magnetic drum computer components. Ls Le Ic RMSa

Bull S. A. Compagnie des Machines, 94 Avenue Gambetta, Paris, France
Punch card machines. Development of electronic computer components. Ls(3000) Le Dc RMSa

Bureau of Census, Washington 25, D. C. *C
Design and construction of statistical processing equipment. Special punch card machines and other machines for own use. Has a Univac. Ls(1100 in Machine Tabulation Division) Le(1890 in punch card field) Dc Ga

Burroughs Adding Machine Co., 6071 Second Ave., Detroit, Mich., and 511 No. Broad St., Philadelphia, Pa. *C

Adding machines, bookkeeping machines, etc. Research division in Philadelphia has made Burroughs Laboratory computer, an electronic digital test computer. Also has completed a fast-access magnetic-core memory to be attached to Eniac; stores 100 numbers of 10 decimal digits; access time 20 microseconds. Pulse control components, servomechanisms. This company owns Control Instrument Co., which SEE. Ls(18,000) Le(1896) DSc RMSPa

Clary Multiplier Corp., 408 Junipero St., San Gabriel, Calif. *C

Adding and multiplying machines, cash registers, electronic counters, automatic read-out devices for electronic computers, data-reduction apparatus, analog-to-digital converters. Ls(1800) Me(1939) DAc RMSa

Commercial Controls Corp., 1 Leighton Ave., Rochester 2, N. Y.

Mailroom equipment. "Flexowriter" electric typewriter with punched paper tape control. Ls Le Ic RMSa

Commonwealth Scientific and Industrial Organization, Radiophysics Division, Sydney, New South Wales, Australia

Maker of CSIRO Mark I electronic digital computer of Inst. for Advanced Study type. DAc RCGPa

Computation Centre, Univ. of Toronto, Toronto, Canada *C

Digital, electronic computers. Now operating: a Ferranti Electric automatic computer; Univ. of Toronto Model Electronic Computer; IBM installation. Ss(15) Se(1947) RPa Dc

Computer Control Co., 106 Concord Ave., Belmont, Mass.

Computers and computer components. Ss Se(1952) Dc RMSCa

Computer Corp. of America, 149 Church St., New York 7, N. Y.

Electronic analog computer. Se Ac RMa

Computer Research Corp., Subsidiary of National Cash Register Co., 3348 West El Segundo Blvd., Hawthorne, Calif. *C

Digital computers, data processing machines, decimal digital differential analyzers, computer components, magnetic components. Computing systems (general and special purpose, business or scientific). CRC10 general purpose computer and other computers. Ms(225) Se(1950) Dc RCMSa

Computing Devices of Canada, Lim., 338 Queen St. (headquarters), and 475 Cambridge St. (laboratories), Ottawa, Ont., Canada *C

Digital and analog computers, automatic navigation systems, electronic laboratory test equipment, simulators, servomechanisms. Research and development in instrumentation, automatic control, business sorting, scientific sorting, systems analysis. Ms(100) Se(1948) DASc RCPMSa

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. *C, *A

Automatic electronic digital computers (Model 30-201). Digital and analog data handling and conversion systems (Sadic, Millisadic, etc.). Automatic translator magnetic tape to punched card. Ls(900) Me(1937) Dc RMSa

Consolidated Vultee Aircraft Corporation, San Diego 12, Calif. *C

Output devices for telemetering and computing systems. The Charactron, equipment including a cathode-ray tube that at high speed converts analog or coded information into alphabetic or numeric light images on the screen. Ss(20 on this project) Se(1951 on this project) Ic RMSa

Control Instrument Co., 67 35th St., Brooklyn, N. Y. *C

Fire-control equipment. 1000-line-a-minute tabulator. Digital and analog machines and components. Now a subsidiary of Burroughs. Ls(1200) Me(1934) DAc RMSa

The de Florez Co., 116 East 30 St., New York, N. Y.

Magazine subscription fulfillment problem, etc. Ss Se DAc RCa

Digital Control Systems, Inc., Top of Mount Soledad, P.O.Box 779, La Jolla, Calif.

Ss Se Dc RMSa

Digital Products Inc., 7852 Ivanhoe Ave., La Jolla, Calif.

Dc Ma

Eastman Kodak Co., 343 State St., Rochester 4, N. Y. *C
High-speed printers: photographic, electro-mechanical, electronic facsimile. Ls Le(1888) Ic RCMSa

Eckert-Mauchly Division, Remington Rand, Inc., 3747 Ridge Ave., Philadelphia, Pa. *C, *A
All-purpose electronic digital computers. Univac Factronic System. Ls (600)? Se(1946) Dc RCMSa SEE also Remington-Rand, Inc.

Thomas A. Edison, Inc., Instrument Division, 22 Lakeside Ave., West Orange, N. J.
Automatic control components. Ls Le Cc RMSa

Electronic Associates, Inc., Long Branch, N. J. *C
Digital-to-analog converter (Model 417). Digital plotting system (Dataplotter). General and special purpose analog computers, and devices. Special purpose digital devices. Ms(350) Se(1945) DAc RMSa

Electronic Computer Div. of Underwood Corp., 160 Avenue of the Americas, New York 13, N. Y., and 265 Butler St., Brooklyn, N. Y. *C
Constructing four types of electronic digital computers (Elecom-100, -120, -200, and a data-handling computer). First Elecom 100 passed acceptance tests 11/22/52 at Aberdeen Proving Ground, including continuous run of 24 hours without error. Delay lines, pulse transformers, magnetic recording heads, magnetic drums, D.C. plug-in amplifiers. Ms(70) Se(1949) Dc RMSa SEE also Underwood Corp.

Electronic Engineering Co., 180 South Alvorado St., Los Angeles, Calif.
Analog computing machinery. Analog-to-digital-to-analog converters. Polar-to-rectangular-to-polar converters. Servomechanisms. Me Se DAc RMSa

Elliott Bros. (London) Ltd., Century-Works, Lewisham, London S.E. 13, England, and Research Laboratories, Elstree Way, Borehamwood, Herts., England *C
Digital and analog computers; servomechanisms. Ls(2000) Le(1800) DASc RMSa

Engineering Research Associates, Division of Remington-Rand, Inc., 1907 West Minnehaha Ave., St. Paul, Minn., and 510 18th St. South, Arlington, Va. *C, *A
Digital computers; ERA 1101 and 1103 electronic digital computers; the Logistics Computer. Magnetic storage systems, including magnetic heads, magnetic drums, etc. Shaft-position indicator systems, self-recording accelerometers, analog magnetic recording systems, data-handling equipment, special purpose communications equipment, pulse transformers. Ls(750) Se(1946) Dc RMCPSa SEE also Remington-Rand, Inc.

Engineers Northwest, 100 Metropolitan Life Bldg., Minneapolis 1, Minn. *C
Test-scoring machines and equipment. Ss(20) Se(1945) DAc RCMa

English Electric Co., Stafford, England *C
Manufacturer of fully engineered versions of ACE (see National Physical Laboratory). Ls Le DIc RMSa

Facit, Inc., 500 5th Ave., New York 36, N. Y. (subsidiary), Stockholm, Sweden (headquarters), and elsewhere *C
Calculators, adding machines, typewriters, etc. (in 1390 A. D., copper mining). Ls(4000) Le(1390) Dc RMSa

Federal Telephone and Radio Corp., Clifton, N. J.
Equipment for airline reservation problem. Ic RMSa

Felt and Tarrant Mfg. Co., Comptometer Division, 1735 North Paulina St., Chicago 22, Ill. *C
Adding-calculating machines, key-driven, electric and non-electric. Comptometer. Ls(1700) Le(1886) Dc RMSa

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y., agent for Ferranti Electric Ltd., Moston, England, and Mount Dennis, Toronto, Canada *C
Complete electronic digital computers (Ferranti; also called "Manchester Universal Electronic Computer"). High-speed photoelectric tape reader, which can read up to 200 characters per second. Magnetic drum and electrostatic storage components, etc. Ls(10,000) Le(1896) Dc RMSa

Ferroxcube Corp. of America, Saugerties, N. Y.
Ferrites; pulse transformer cores; computer components. Ms Se Ic RMSa

Foxboro Co., Foxboro, Mass.
Automatic controllers. Ls Le Cc RMSa

Ford Instrument Co., Division of the Sperry Corporation, 31-10 Thomson Ave., Long Island City 1, N. Y. *C
Gun fire control apparatus. Analog computers and components, magnetic amplifiers, servo motors, differential and integrator elements. Instruments for shipborne and airborne armament and navigational control. Ls(3800) Le(1915) ASc RMSa

The Franklin Institute Laboratories for Research and Development, 20th St. & Benjamin Franklin Parkway, Philadelphia 3, Pa. *C
Fire control equipment. Special purpose analog computers, large and small scale. Digital computer components. Prototype construction. Ms(300) Se(1946) DAc RCa

Friden Calculating Machine Co., Inc., San Leandro, Calif. *C
Desk calculating machines. Computyper. Ls(2000) Me(1934) Dc RMSa

General Ceramics and Steatite Corp., Keasbey, N. J. (near Perth Amboy, N.J.) *C, *A
Magnetic cores for computer components; technical ceramics, insulators, etc. Magnetic Amplifiers, Inc., Bronx, N. Y., is an affiliate. Ls(650) Le(1906) Ic RMSa

General Controls, 801 Allen Ave., Glendale 1, Calif. *C
Automatic controls (pressure, temperature, level, flow). Ls Cc RMSa

General Electric Co., Syracuse, N. Y., and Schenectady, N. Y. *C
Digital and analog, electric and electronic, computers and analyzers. Network analyzers. Automatic electronic digital computers, OARAC. Ls(90,000?) Le Ic RMSa

General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
Magnetic amplifiers and control systems, magnetic multipliers, computer modulators, etc. Ss(30) Se(1949) Ic RMSa

Gerber Scientific Instrument Co., 89 Spruce St., Hartford 1, Conn. *C
Graphical computer "Graphanalogue". Ss Se(1946) Ac RMSa

Goodyear Aircraft Corp., Dept. 65A, Akron 15, Ohio
Goodyear electronic differential analyzers (Geda). Ac RMa

Haller, Raymond, and Brown, Inc., State College Pa. *C
Electronic digital computer for solution of up to 1200 simultaneous equations, using magnetic drum and tape. Research and development on computer components, analog computers, electronic and electromechanical systems Ms(100) Se(1946) DAc RMSa

Harvard Computation Laboratory, Cambridge 38, Mass.
Harvard Mark I, II, III, IV calculators for Navy, Air Force, and own use. Ms Se Dc RPMa

Hillyer Instrument Co., 54 Lafayette St., New York, N. Y.
Simulators, servomechanisms, sensing, computing, and actuating systems. DAICc RMSa

Hogan Laboratories, 155 Perry St., New York, N. Y. *C
Facsimile machines. Digital, high-speed printers and computers. Manufacturing the Circle Computer. Ms(60) Me(1929) Dc RMSa

Hughes Research and Development Laboratories, Hughes Aircraft Co., Culver City, Calif.
Automatic data handling systems. Industrial process control systems. Small powerful electronic digital computer. Fire-control equipment. Aircraft control. Navigation systems. Ls Me DAc RMSa

Institut Blaise Pascal, Laboratoire de Calcul Analogique, 155, rue de Sèvres, Paris 15, France
Ac RPa

Institut Blaise Pascal, Laboratoire de Calcul Mécanique, 25, Avenue de la Division LeClerc, Chatillon-sous-Bagneux (Seine), France *C
Constructing a digital calculator. Ss(9) Me(1939) Dc RPa

Institute for Advanced Study, Princeton, N. J.
"Maniac", big fast electronic digital calculator, for own use. Dc RPMa

Intelligent Machines Research Corp., 134 So. Wayne St., Arlington, Va. *C, *A
Devices for reading characters on paper, etc. Pattern interpretation equipment. Sensing mechanisms. Digital computer elements. Ss(6) Se(1951) Dc RCMSa

International Business Machines Corp., 590 Madison Ave., New York 22, and elsewhere *C
Punch card machines. IBM Electronic Data Processing Machines, Type 701 (magnetic tape, magnetic drum, electrostatic storage). Card Programmed Calculator. Electronic calculating punch Type 604. Data processing equipment. Process control equipment. Automatic Source Recording Equipment. Ls(42,000) Le(1911) Dc RMSa

International Telemeter Corp., 2000 Stoner Ave., Los Angeles 25, Calif. *C
Digital computer Type TC-1 (like Ordvac). Special devices for clerical and control applications. Metered and piped television. Ss(41) Se(1951) DIc RMSa

International Telephone and Telegraph Corp., 67 Broad St., New York, N. Y.
Equipment for airline reservation problem. Fully automatic pneumatic tube system, by dialing. Ic RMSa

Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda 14, Md. *C
High-speed small, compact digital computers (Jaincomp A, B, B1). Pulse transformers, delay lines, magnetic storage systems. Input and output devices. Complete instrument systems. Ms(60?) Se(1948) DASCc RMSa

Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena 3, Calif.
Analog, digital, and data-handling systems. Ls(500; about 50 on computers) Me(1940) DAc RCPa

Ketay Manufacturing Co., 595 Broadway, New York 12, N. Y., and elsewhere
Automatic control systems; synchros, selsyns, resolvers, magnetic amplifiers, rotational electronic gear; servomechanisms. Ls(1600) Se(1943) Ic Sc

A. Kimball Co., 307 West Broadway, New York 13, N. Y. *C
Machine for printing and punching garment tags. Input mechanisms. Ms(200) Le(1876) Ic RMSPa

Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass. *C
Special computers to suit customer requirements. Ms(425) Se(1946) DASc RCMPSa

Leeds and Northrup, 4901 Stenton Ave., Philadelphia 44, Pa. *C
Automatic recorders and controls. Ls(3150) Le(1899) Cc RMSa

Librascope, Inc., 1607 Flower St., Glendale 1, Calif. *C
Mechanical and electrical analog computers; primarily special-purpose. Ls(600; about 30 on computers) Me(1937) DASc RMSa

Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Mass. *C
Analog digital converter, "Automatic Digital Recorder of Analog Data" (ADRAD). Conversion and input devices. Ls(550) Le(1886) Ic RCa

Logabax Co., 12, rue de l'Arcade, Paris, France
Collaborating with Institut Blaise Pascal on computing devices. DIc RMSa

Logistics Research Inc., 141 So. Pacific Ave., Redondo Beach, Calif.
Digital computers, computing systems, data-handling systems, automatic graph plotters, input-output equipment for digital computers. Ms(50) Se(1952) Dc RCMSa

W. S. Macdonald Co., Inc., 33 University Rd., Cambridge, Mass. *C
Digital business machines using magnetic drum memory for 10,000 registers. Ss(20) Se(1946) Dc RMSa

Magnetic Metals Co., Hayes Ave. & 21st St., Camden, N. J. *C
Magnetic memory storage units for digital computers. Magnetic cores, tapes, laminations for magnetic amplifiers, servomotors, etc. Ms(380) Se(1942) Ic RMSa

Marchant Calculators, Inc. (formerly Marchant Calculating Machine Co.), Oakland 8, Calif. *C
Desk calculators. Electronic digital computers. Marchant-Raytheon Binary-Octal desk calculator. Ls(2500) Le(1910) Dc RMSa

Marchant Research, Inc., Oakland 8, Calif. (formerly Physical Research Laboratory, Pasadena, Calif.) *C
Electronic digital computers (including Miniac). Magnetic storage systems, magnetic heads, data handling equipment including analog-to-digital converter, computer components. Ss Se Dc RMSa

Massachusetts Institute of Technology, Digital Computer Laboratory (formerly Servomechanisms Laboratory); also Center of Analysis; Cambridge 39, Mass.
"Whirlwind" electronic digital computer. Ms(300+) Se(1945?) DAc RCPa

Mathematisch Centrum, Amsterdam, Netherlands
Relay computer in use; electronic computer under construction. Dc RCPa

The W. L. Maxson Corp., 460 West 34 St., New York, N. Y.
Servomechanisms, digital computers, analog computers. Ls(3000) Me(1935) DASc RMSa

Mellon Institute of Industrial Research, Multiple Fellowship on Computer Components, Univ. of Pittsburgh, Pittsburgh 13, Pa. *C
Ss(6) Se(1950) Dc RCa

Mid-Century Instrumatic Corp., 611 Broadway, New York 12, N. Y.
Components for electronic analog computers: function-generators, multipliers etc. Ss(20) Se(1947) Ac RMSa

Minneapolis-Honeywell Regulator Co., Industrial Division, 4580 Wayne Ave., Philadelphia 44, Pa. *C
Automatic controllers. Brown Instruments. Servo components used in computers. Recording and indicating instruments and control equipment. Ls (3500) Le(1859) Cc RMSa

Minnesota Electronics Corp., 47 West Water St., St. Paul 1, Minn. *C
Digital and analog computers. Magnetic components, magnetic decision elements. Data reduction systems, telemetering. Ss(35) Se(1946) DAIc RMSa

Monrobot Corp., Morris Plains, N. J. *C
Electronic digital computers. Adding, calculating, bookkeeping and electronic digital computers; Monrobots. Subsidiary of Monroe Calculating Machine Co. Ss(32) Se(1953) Dc RMSa

Monroe Calculating Machine Co., Orange, N. J. *C
Desk calculating machinery. SEE Monrobot Corp. Ls(4000) Me(1925) Dc RMSa

Moore School of Electrical Engineering, Univ. of Pennsylvania, Philadelphia, Pa. *C
Place where Eniac, and Edvac electronic digital computers were constructed. Constructing MSAC (Moore School Automatic Computer). Ms(80) Me(1923) DAc RCPMa

National Bureau of Standards, Division of the National Applied Mathematics Laboratories: *C

(1) Computation Laboratory, Washington 25, D. C.
SEAC, Bureau of Standards Eastern Automatic Computer. Ms(100) Me(1938) Dc RCPGa

(2) Institute for Numerical Analysis, 405 Hilgard Ave., Los Angeles 24, Calif. SWAC, Bureau of Standards Western Automatic Computer. Ms(100) Se(1947) Dc RCPGa

(3) Machine Development Laboratory, Washington 25, D. C.
Specifications development. Systems analysis. Ss(10) Se(1947) Dc RCGa

National Bureau of Standards, Electronics Division, Electronic Computers Section, Washington 25, D. C. *C
Ms(80) Se(1946) Dc RCMGa

National Cash Register Co., Main and K Sts., Dayton, Ohio, and elsewhere. *C
Cash registers. Accounting-bookkeeping machines. Adding machines. Purchaser of Computer Research Corporation. Ls(33,000) Le(1884) Ic RMSa

National Physical Laboratory, Electronics Section, Teddington, Middlesex, Eng. *C
Digital computers and associated equipment. Designer and builder of the Pilot Model of ACE (Automatic Computing Engine -- high-speed, electronic, digital). Collaborates with English Electric Co. Ls(1000; Elecnc Sec 25) Le(1900; Elecnc Sec 1948) DIc RCPMa

Northrop Aircraft Co., Hawthorne, Calif.
Computing center; develops, maintains, operates own computing equipment. Ms(50 this project) Se(1950 this project) DAc RCPa

Nuclear Development Associates, 80 Grand St., White Plains, N. Y. *C
Design and development of Circle Computer. Associated with Hogan Laboratories. Ss Se DIc RMSa

Olivetti Corp. of America, 580 Fifth Ave., New York 36, N. Y., and associated companies elsewhere. *C
Desk adding, calculating, and printing machines. Fully automatic printing calculators. Ls(6000) Le(1908) Dc RMSa

Ortho Filter Corp., 198 Albion Ave., Paterson, N. J.
Plug-in units for electronic digital computers. Ms(33) Se RMSa Ic

Panellit, Inc., 6312 North Broadway, Chicago 40, Ill.
For automatic control: coordinated and graphic control panels for process variables; multiple point scanning systems; annunciator systems. Cc RMSa

Pennsylvania State College, X-Ray and Solid State Lab., Dept. of Physics, State College, Pa. *C
X-RAC computer for crystal electron density functions. S-FAC for structure factor calculations. R-PAC (recorder playback computer) for Patterson function interpretations. Ms(55) Se(1947) Ac RPa

George A. Philbrick Researches, Inc., 230 Congress St., Boston 10, Mass. *C, *A
Philbrick electronic analog computing equipment and components. Ss(5+) Se(1946) Ac RCMSa

Photon, Inc., 58 Charles St., Cambridge 38, Mass. *C
Machinery for composing type by photographs. First photographically-composed book has been published. Ms(100) Me(1940) DIc RCMSa

Pitney-Bowes, Inc., Stamford, Conn. *C
Postage meters. Tax-stamping meters. "Tickometer" counting and/or imprinting machines. Ls(3000) Le(1920) Ic MSa

Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. *C
Electronic counters. Electronic tag reader. Random access memory. High speed printer ("flying typewriter"). Ms(100) Se(1942) Dc RCMSa

Powers-Samas Accounting Machines Sales, Ltd., 814 North Michigan Ave., Chicago 11, Ill., agent for Powers Samas Accounting Machines Ltd., England.
Punch card tabulating equipment using small, medium, and standard cards. Agency transferred to Underwood Corp., which SEE. Ls(6000) Le(1916) DIc RMSa

Productions Electroniques, 8, rue Laugier, Paris 17, France
Collaborating with Institut Blaise Pascal on magnetic recording devices. Ic RMSa

Radio Corp. of America, Laboratories, Princeton, N. J.; RCA Victor Div., Camden, N.J. and Harrison, N. J. *C
Selective electrostatic storage tube (formerly Selectron), Radechon, Graphecon, Williams Tube, Time Interval Counter, Computer systems. Magnetic matrix memory. Ls Le Ic RMSa

The Rand Corporation, 1700 Main St., Santa Monica, Calif. *C
Constructing an electronic digital computer of the type of the Institute for Advanced Study. Ls(500) Se(1946) DASIc RCPa

Raytheon Manufacturing Co., Waltham, Mass. *C
Radar, fire-control, microwave equipment. Big fast electronic digital computers (Raydac), one delivered. Tape handling mechanisms, magnetic heads, magnetic cores, shift registers. Ls(20,000) Me(1924) DAc RMSa

Reeves Instrument Co., 215 East 91 St., New York, N. Y. *A
Fire-control equipment. "REAC" electronic analog computers. Ls Me Ac RMSa

Remington Rand, Inc., 315 4th Ave., New York 10, N. Y., and elsewhere. *C, *A
Punched card machines, office machines, electronic digital computing machines (Univac Factronic System, ERA 1101, ERA 1103), servomechanisms. Ls (30,000; 1800 on computers) Le DASc RCMSa SEE also Eckert-Mauchly Division, and Engineering Research Associates Division.

Robotyper Corporation, Hendersonville, N. C.
Automatic typing equipment that can be associated with any electric typewriter, using a record roll pneumatically operated. Ic RMSa

Scientific Computing Service, Ltd., 23 Bedford Sq., London, W. C. 1, England *C
Ss(16) Me(1938) DAIc CPa

Servo Corporation of America, New Hyde Park, N. Y. *C
Servomechanisms. Automatic controls. Analysis and synthesis for controls manufacturers. Ms(220) Se(1946) SCc RMSa

Servomechanisms, Inc., Post and Stewart Aves., Westbury, N. Y. *C
Automatic control systems, and components. Analog computers. Ls(700) Se(1946) ASc RMSa

Société d'Electronique et d'Automatisme, 138 Blvd de Verdun, Courbevoie, Seine, France *C
Analog and digital computers. Servomechanisms, electronic equipment for machine tools. Ms(300) Se(1948) DASc RMSa

Sperry Gyroscope Co., Great Neck, N. Y. *C
Ordnance; fire-control equipment. Automatic controls. Navigation equipment, sea and air. Radar, Loran, gyrocompasses, precision instruments. Ls(18,000) Le(1910) Ac RMSa

Swedish Board for Computing Machines, Drottninggatan 95A, Stockholm, Sweden *C
Planned the relay computer BARK (Binary Automatic Relay "K"omputer which was then built by the Royal Telegraph Administration. BARK has run commercially since July 1950. Planning and constructing an electronic computer of the Princeton type. Ss(30) Se(1949) Dc RMCPa

Sylvania Electric Co., 70 Forsyth St., Boston 15, Mass. *C
Big fast electronic analog and digital computers, for government. Subassemblies of diodes and triodes. Ls(1200) Se(Company, 1901; this division, 1945) DAc RMSa

Taller and Cooper, 75 Front St., Brooklyn, N. Y. *C
Data recording and conversion systems, printers, perforators. Function generators, computers. Toll equipment for bridges, highways, turnpikes. Ms(250) Me(1926) DIc RMSa

Tally Register Corp., 5300 14th Ave., N. W., Seattle 7, Wash. *C
Special purpose business machines and instruments. High-speed data-reduction system for telemetering applications; electrosensitive tape recorders and readers; tape-to-card converters; binary-decimal converters; data input devices. Ss Se DICMc RMSCa

Taylor Instrument Co., Rochester, N. Y.
Automatic controllers. Ls Le Cc RMSa

Technitrol Engineering Co., 2751 No. 4 St., Philadelphia 33, Pa. *C
Computing and control equipment. Complete digital systems. Components, pulse transformers. Electrical and acoustic delay lines. Ms(65) Se(1947) DAc RMSa

Telecomputing Corp., 133 E. Santa Anita Ave., Burbank, Calif. *C
Automatic data reading, recording, and plotting equipment (telereader, Telecordex, Teleplotter). Ms(160) Se(1947) Dc RMPa

Teleregister Corp., 157 Chambers St., New York 7, N. Y. *C
Digital and analog special purpose computers. Data inventory systems for special applications — travel reservations, flight data processing, stock market quotations, etc. Magnetronic Reservisor, in use at American Airlines' reservations center. Magnetronic stock quotation system now in use at Toronto Stock Exchange. Associated with Western Union. Ms(275) Me(1928) DAc RMSa

Teletypesetter Corp., 7 Dey St., New York, N. Y.
Machines that set linotype at a distance. Ic RMSa

John E. Thompson and Associates, 7210 So. Yates Ave., Chicago 49, Ill. *C
Ss(10) Se(1946) Ac Ma

Transmitter Equipment Manufacturing Co., Inc., 345 Hudson St., New York 14, N. Y.
DAc Ma

Ultrasonic Corp., 61 Rogers St., Cambridge 42, Mass. *C
Automatic feedback control development and equipment. Ms(450) Se(1945) DACc RMSa

Underwood Corp., One Park Ave., New York 16, N. Y.; General Research Lab., 56 Arbor St., Hartford 6, Conn.; and elsewhere. *C
Accounting machines, adding machines, typewriters. Elliott-Fisher and Sundstrand machines. Underwood electric typewriters, used in Harvard Mark II calculator. Ls(company 10,000; laboratory, 100) Le(1895) DIc RMSa

Union Switch and Signal Co., Division of Westinghouse Airbrake, Pittsburgh 18, and Swissvale, Pa.
Railroad signaling and control systems. Ls(4000) Le Ic RMSa

U. S. Air Force, Cambridge Research Center, 230 Albany St., Cambridge 39, Mass.
Developed the ABC (Automatic Binary Computer). Has a Computer Research Corp 102. Ms Me DIc Ga

U. S. Air Force, Inst. of Technology, Wright-Patterson Air Force Base, Dayton, Ohio *C
Electronic strategy machine, conceived by L. I. Davis. Philbrick and Reac equipment on hand. Ms(300) Se(1946) DAIc Ga

U. S. Air Force, Office of Air Research, Wright-Patterson Air Force Base, Dayton, O.
Assembling a computing laboratory. Has OARAC. Ms Se Dc RCPa

U. S. Army, Ballistic Research Laboratories, Aberdeen Proving Ground, Aberdeen, Md. *C
Has Bell, Edvac, Eniac, Ordvac computers and others. Developing supplementary and modernizing components. Ms Le DAc Ga

U. S. Naval Proving Ground, Computation and Ballistics Division, Dahlgren, Va. *C
Has Harvard Mark II relay and Mark III electronic digital computers. Ms (200) Se(1942) Dc Ga

U. S. Naval Research Laboratory, (Anacostia, Md.), Washington 25, D. C. *C
Making NAREC digital computer. Ls(3000) Me(1923) Ic RCGPa

Univ. Mathematical Laboratory, Free School Lane, Cambridge, England
Has EDSAC electronic digital calculator. Dc RCPa

Univ. of California, Berkeley, Calif. *C
Constructing CALDIC, California Digital Computer. Dc RPa

University of Illinois, Urbana, Ill.
Built electronic digital computer Ordvac for Ballistic Research Laboratory, Aberdeen. Has finished computer Illiac on same design, but with faster input-output using a photoelectric reader. Dc RCPa

University of Manchester, Mathematical Laboratory, Manchester, England *C
Has automatic electronic digital computer built by Ferranti Electric, Ltd.
This laboratory developed much of the design. Ss(8) Se(1947) Dc RPa

Univ. of Michigan, Willow Run Research Center, Willow Run Airport, Ypsilanti, Mich.
*C High-speed digital computers, including MIDAC. Electronic and electro-mechanical analog computers. Special purpose computing equipment.
Ls(500) Se(1946) DAc RCPa

University of Sydney, Dept. of Electrical Engrg., Section of Mathematical Instruments, Sydney, New South Wales, Australia
Analog computers. Ac Ra

Victor Adding Machine Co., 3900 No. Rockwell St., Chicago 18, Ill. *C
Adding machines. Ls(1600) Le(1918) Dc RMSa

Wallind-Pierce Corp., 1928 Pacific Coast Highway, Lomita, Calif. *C
Digital-to-analog, and analog-to-digital translators. Digital and analog computers, magnetic amplifiers, etc. Ss(18) Se(1951) DASc RCMSa

Wang Laboratories, 296 Columbus Ave., Boston 16, Mass. *C
Magnetic delay-line memory units. Digital signal generators. Multiple scalers. Static magnetic memory systems and other devices. Ss Se(1951)
Dc RCMSa

George Washington Univ., Logistics Research Project, 707 22nd St., Washington 6, D.C.
*C ONR relay computer with magnetic drum memory. Data-handling machines.
Fast output. Ss Se(1949) Dc RCPa

Watson Scientific Computing Laboratory, 612 West 116 St., New York, N. Y. *C
The pure science department of International Business Machines. Simultaneous linear equation solver. Astronomical plate measuring machine.
Ms(75) Se(1945) DAc RCPa

Wayne University, 5135 Cass Avenue, Detroit 1, Mich. *C
Computation laboratory. Now has the first MIT differential analyzer. Acquiring a large digital computer from Burroughs. Ss(10) Se(1950)
DAc RCPa

Weems System of Navigation, 227 Prince George St., Annapolis, Md.
Automatic navigation systems. Me Ic RCPMSa

Westinghouse Electric Corp., Industry Engineering Dept., East Pittsburgh, Pa. *C
Analog computers for: mechanical and electrical problems; regulating systems; servomechanism behavior; flow of heat, oil, or gas; other purposes.
DC and AC calculating boards. ANACOM computer. Ls Le DASc RCMSa

Wharf Engineering Laboratories, Fenny Compton, Warwickshire, England
Magnetic drums for computers. Ss Se Dc RMSa

Zator Co., 79 Milk St., Boston 9, Mass. *C
Equipment and systems, for coding, filing, and finding information (Zatocoding systems). High-speed selectors for notched cards. Methods for use of digital computing machines to recover information. Ss Se(1947)
Ic RCSa

Konrad Zuse, Neukirchen, Germany
Has made Zuse Model IV computer. Se Dc RMSa

AVENUES FOR FUTURE DEVELOPMENTS IN COMPUTING MACHINERY

By Edmund C. Berkeley

Probably nobody, when first approaching the field of computing machinery, can see its full extent. Those of us who come into the field having some experience with hand calculations may think of it mainly as superpowerful calculating machinery. Others who come into the field after experiments on the nervous systems of animals may think of it mainly as extraordinary but limited machinery for internal communication between the parts of an organism. All of us are hedged in and conditioned by earlier thinking that is naturally to some extent provincial.

For example, this provincialism is reflected in the selection of the title for a recent article in a well-known magazine: "Electronic Calculators: Brainless but Bright". Whether the epithet is presently true or not, it is less than fifteen years since the field of computing machinery began to mushroom; and a man is rash indeed if he classifies future possibilities as impossible by what has actually happened so far.

There are enormous vistas to be glimpsed in this new field of computing machinery. Using our imagination, let us consider what are the possible avenues for future developments. For centuries, the airplane also was a "brainless" idea; but imagination and speculation have an important role to play if either men or their ideas are to have wings.

Avenue No. 1: Kinds of Information

Computers are often classified these days according to whether they are analog type, handling information represented by measurements, or digital type, handling information represented by digits and characters. But -- Avenue No. 1 -- why not have machines which can handle information in both ways?

Such machines have begun to appear. One for example, called the digital differential analyzer, performs an analog process in a digital way. But ideally there should be no restriction. We can foresee a computer possessing both analog and digital capacity, each capacity able to be used at any time when desirable.

There are likely to be other kinds of information than just digital and analog. For example, some psychologists say that the handling of information in human brains is accomplished using images, recollected or imagined pictures. Little as we may be able to find out about brains, why not use such suggestions as these for developing more ways for computers to handle information?

Avenue No. 2: Mediums for Information

At the present time, many kinds of physical mediums for expressing information are used: punch cards; punched paper tape; magnetized surfaces; etc. But in how many possible mediums can information be represented conveniently for machine handling? This avenue is under intensive development. Every year reports new mediums for storing and transferring information. Some of the latest are transistors and magnetic cores. But some of the old mediums should not be lost sight of, such as the compressed air line of the pneumatic controller.

Avenue No. 3: Programming

In order to cause a computer to solve a problem at the present time, most computer men have to stop and prepare a specific sequence of appropriate instructions (or program) for the machine to carry out.

But programming is arduous work. Why not cause the machine to program itself? Why not provide for the "education" of computers?

This avenue has begun to be developed, notably by the Univac Applications Group in Philadelphia.

Avenue No. 4: Applications

Machinery that handles information has so far been applied in scientific, military, engineering and business applications. But wherever information is handled in quantities, it is reasonable to expect important applications of computing machinery. What are the fields where very large amounts of information are handled?

One brief, incomplete list is: insurance, banking, government, post office, department stores, mail order, market research, railroads, airlines, magazine subscription fulfillment, libraries, armament testing, linguistic translation, logistics planning. Life-times could be spent in studying types of problems in these areas, and bringing them to the attention of engineers for designing information-handling machinery that will solve them.

Avenue No. 5: The Imitation of Behavior

The argument about whether a computing machine "thinks" or "does not think" pays a compliment to the computing machine: it admits that much of the behavior of a computing machine is a creditable imitation of thinking! No matter how we decide about the argument at the moment, it does point out an important avenue of development for computing machinery combined with acting machinery — computer plus automation. That avenue is this: what are all the kinds of behavior of animals, and of processes of nature, and of human beings? which of those kinds of behavior would we like to imitate with a computing automaton, a self-acting self-regulating machine? and how can we imitate?

For example, consider the process of seeing and recognizing, a common and useful kind of behavior in the living world. In the hardware world so far, we have color movies and color television; also we have at least one scanning machine (built by Intelligent Machines Research Corp.) which will "see" and "recognize" printed letters and digits, and act accordingly. Of course, the hardware of 1953 is still a very long way from the compact, continuous, low-energy, chemically-based, color movie with recognizing powers that we each carry around with us most of our lives. But at least the present state of hardware is a beginning, and it points to an important future direction for development.

Certainly there are more than a few avenues for future developments in computing machinery. It might not be a bad plan to try to be aware of as many of them as possible.

HUNGARIAN PRELUDE TO AUTOMATION

by Gene J. Hegedus

Long Island City, N. Y.

(from a letter to the Editor)

For almost forty years I have been an avid fan for "Automatics" — a younger brother of which is "Computing Machinery". The first time I encountered it was at the age of seven in Budapest when I had to start studying and practicing to play the violoncello, because according to the opinion of my father, music was an important part in the cultural education of man, and he was the kind of man who took care that his opinions and decisions were respected. My two elder sisters at the time were studying violin and piano at the Royal Academy of Music in Budapest. They, wary lest they were to be charged with my musical education, persuaded him that, for the composition of the family orchestra, since three more little brothers and sisters were prospects for future membership, a diversity of instruments would be necessary. This made Father decide for the 'cello. Since his opinion was "do something right or don't do it at all," he decided on the necessity of 2½ hours practice for me every day. This meant for me giving up 2¼ hours of reading, because according to my opinion fifteen minutes practice daily was sufficient to appear prepared whenever my lesson was due.

Having mastered the three R's at 3½ and read books like Robinson Crusoe at four, I had been for three years a member of the local library; the fees for the membership came from secret funds of my mother, who reasoned that that small sum per month cost considerably less than a ruined couch and/or several broken windows. I forgot to mention up to here that I was a boy.

Try as I would, I could not get out of the ordeal. My two older sisters, having reached the venerable age of 12 and 14 and become members of the highly respected Royal Academy, operated under the honor system. However my practising hours were set to start at 4 p.m., the closing time of my father's business. Every fifteen minutes he would rise, traverse the dining room behind which my little music study was, and put his head through the door. Either he found me actively engaged in practising the 'cello, or ...... let's forget sad details.

There was nothing I could do about it. Father kept the outer door of the dining room well oiled, and its heavy rug absorbed approaching sounds. But two weeks later I found the answer right in the high school physics book of my sister.

Fortunately at this time we only had gas lighting in our apartment; I say fortunately, because if we had had electric current, I probably would have electrocuted myself in the exciting first days of my new discovery. But we did have a large sized wet battery, which served to supply current for our doorbell. An old useless doorbell begged from the janitor, some long thin silver wires unraveled from several 'cello C strings installed along the wall moldings, and a pair of contacts on the outer door made a reliably working relay circuit, which would close its contact the second anybody opened the outside door of the dining room. The circuit lighted up a small flashlight bulb, fixed on my music stand. It took me but two seconds to throw the book I was reading below the couch, and since I never left the practising position, sitting with the 'cello between my legs in front of the music stand, Father would hear me playing before he was halfway across the room. This seemed to me a satisfactory arrangement to evade the "useless" practising.

However I reckoned without Father. He just could not believe that I had changed into such a good boy, who would not do wrong under any circumstances. He started to observe things, and his attention was caught by the wire installation which terminated at the bell battery. He did not know a thing about electricity. But with his characteristic courage he tackled this "newfangled" science. He bought a book, and inside one week he knew what he wanted to know. During my school hours he inspected my installation and made sure how it worked; then after I settled down to "practice", he disconnected the leads at the battery, walked carefully through the dining room and caught me red-handed.

I could not help being his son; the whipping I received did not make me give up my will against his. It took me but one week, -- and one special whipping for having run down the battery by subjecting it to excessive load, -- and I had the solution to my problem. I reversed my relay and made out of it a closed circuit, changed the contacts on the door, and now my lamp would light up when either the door opened or when somebody took the leads off the battery. Of course I had to learn under physical pain that this type of relay had to draw considerably less current than the open circuit type, but in another day I had a crude homemade affair, which would keep the contacts open without draining the battery in a short time.

Father never caught me in this particular again, but I was myself caught by automatics. For 38 years since then it has been like a happy marriage -- I know that I am not a free man, yet I don't want to be free. (And I am not even a bad 'cello player, while my five brothers and sisters are good violinists, and one of them even a concert-master.)

WHO'S WHO IN COMPUTERS AND AUTOMATION: SECTION 1 -- PROGRAMMING

(Second edition, supplementary, information as of March 25, 1953)

This is a third installment of a Who's Who of individuals in the field of computers and automation. The purpose of this Who's Who is to make it easier for all persons interested in this field to get in touch with each other in appropriate ways.

Contents. The following list consists of persons interested in computing machinery who have reported as a main interest "programming" and for whom information has been received December 21, 1952 to March 25, 1953. Other persons whose main interest is programming are included in the first installment of Section 1 published in the January, 1953 issue.

Reporting. If you are interested in any phase of computing machinery, robots, cybernetics, or automation, and if you would like to be included in the Who's Who, please send us: your name (please print), address, organization (and its address), your title, main interests (note list appearing under "Entry" below, and specify any other interests), year of birth, your college or last school, years of experience in the field, your occupation, and any more information about yourself that you may care to furnish. Your listing in the Who's Who does not depend in any way on your subscribing to COMPUTERS AND AUTOMATION although of course your subscription will be welcome.

Entry. Each entry in the Who's Who when it become complete contains: name / title, organization, address / interests / year of birth, college or last school (background), years in field, occupation. The address has been substantially contracted to avoid the nuisance of unwanted mail. In cases where no information has been given (for example, about occupation) a "-" denotes omission.

Abbreviations. Since a great deal of information is to be presented, abbreviations have been extensively used. Nearly all these abbreviations can be easily guessed, like those in a telephone book. The letters A,B,C,D,E,M,P,S stand for main interests "Applications, Business, Construction, Design, Electronics, Mathematics, Programming, Sales" respectively.

Geographical Arrangement. Since at the present time many people interested in programming are trying to achieve greater communication among themselves, this section of the Who's Who has been arranged geographically.

Liability. Although we have tried to make each entry complete and accurate, we assume no liability for any statements expressed or implied.

Corrections. We shall be very grateful for any information, additions, or corrections that any reader is able to send us.

Roster

MASSACHUSETTS: Battin, Richard H / mathn, Instrmn Lab, MIT, Camb / AMP / '25, MIT, 1, mathn.

Chin, Edward S / mathn, Baird Assoc, Camb / CDMP / '24, Boston U, -, mathn

Clippinger, Richard F / hd, Compg Serv Sec, Raytheon, Waltham / ABMP / '13, Harv (PhD), 7,

Cross, Rowland Edward / -, New Eng Mut Life Ins Co, Boston / MP / '24, -, 1, acty

Dimsdale, Bernard / asst to hd, Compg Serv Sec, Raytheon, Waltham / AMP / '12, U Minn, 6, -
Hazel, Inez B / -, Dig Comp Lab, MIT, Camb / AMP / '20, Columbia, 3, mathn
Nies, Perry L / apln engr, Ultrasonic Corp, Camb / ABDEPS / '27, Harv Bus Sch (MBA), MIT (BSEE), 2, elec engr

CONNECTICUT: Blake, Kenneth Reynold / compg analyst, Res Dept, United Aircraft / AMP / '28, U Wis, 1, mathn
Votaw, D F, Jr / asst prof math, Yale U, New Haven / ADMP / '18, Princeton U, 6, res & teachg

NEW YORK: Beter, Ralph H / asst dev engr, Arma Corp, Bklyn / ACDP / -, Marquette U, 1, engr
Breiding, Eugene J / des engr, IBM, Pkpsie / ABCDEMPS / '18, U Ky (BSEE), 1, elecnc engr
Finlayson, Lorne D / -, Engrg Div, Corning Glass Works, Corning / ABMP, process control / '12, McMaster U, Toronto U, 3, process analyst
Goldfinger, Roy / Univac prgmr, Inst for Math & Mech, NYU / AMP / '25, NYU, -, -
Murphy, Eugene F / instr, Met Life Ins Co, N Y / ABP, training, educ / '22, NYU, 10, teachr office meth & mngm .
Nellen, Harry G / supvr sys, Pacific Fire Ins Co, N Y / ABEP / '20, Rutgers Ext U, -, acctnt
Thomas, Walker H / techl engr, IBM, Pkpsie / ADMP / '27, Vanderbilt U, 1, -
Welmers, Everett T/chf, Dynamics, Bell Aircraft Corp, Buffalo / ABMP, teachg / '12, U Mich, 5, mathn & engr

NEW JERSEY: Boron, Stanley J / mathn, Esso Std Oil Co, Bayway Refinery, Linden / AMP / '24, Seton Hall U (BS'51), Columbia U ('52), 3, prgmg & operg IBM card prgm calc
Gracey, Milton E / suprv, RCA Serv Co, Gloucester / ABEMP / '14, Rutgers, 15, IBM suprv
Harris, James R / techl staff, Bell Telephone Lab, Dover / ADEP / '20, Polytech Inst Bklyn, 3, -
Moore, Edward F / Bell Telephone Lab, Murray Hill / DMP / '25, Brown U, 4, mathn
Tuckerman, Bryant / mathn, Elecnc Comp Proj, Inst Adv Study, Princeton / MP / '15, Princeton U (PhD'47), 2, mathn
White, J Hunter, Jr / -, -, River Edge / P / -, -, -, -

PENNSYLVANIA: Bartik, Jean J (Mrs) / -, -, Hatboro / ADP / '24, U Pa, 6, housewife
Bowman, John R / hd, Dept Res Phys Chem, Mellon Inst, Pgh / ACDEMP / '10, U Pgh, 12, -
Delaney, Frank M / prgmr, Rem Rand, Phila / ASMP / '23, Temple U, 1, prgmr
Edwards, Helen E / -, US Bur Mines, Pgh / MP / '26, Thiel Col, 3, mathn
Fisher, M D / prgmr, Eckert-Mauchly Div, Phila / MP/ '25, Syracuse U, 2, prgmr
Goldstein, Leon / mathn, USAF Comptroller "Proj Scoop" / AMP / '07, U Pa, 3, mathn
Hawes, Mary K / sr prgmr, Eckert-Mauchly Div, Phila / ABPS / '10, U Okla, Temple U, 2, prgmr
Kahrimanian, Harry G / prgmr, Rem Rand, Phila / AMPS / '21, Temple U, 1, prgmr
Koss, Mildred Adele / prgmr, Eckert-Mauchly Div, Phila / P / '28, U Pa, 2, prgmr
Lawrence, David H / fld rep, Apld Sci Dept, IBM, Phila / ABMPS / '22, U Pa (MS'50), 1, mathn
Miskjian, Vahram G / elecnc engr (sys grp), The Glenn L Martin Co, ? / ADEMP / '06, Purdue U, 6, sys engr
Steele, James H / comp engr, Westinghouse Elec Corp, Pgh / ACDEP / '22, Brown U, U Pgh, 3, elec engr

Sweeney, Harold E / prgmr chf op, Rem Rand, Phila / ABMPS, opern & maint / Temple U, 13, prgmr
Utman, Richard E / eqpm dev ofcr, Navy Aviation Supply Office, Phila / ABP, business data-processing / '26, -, 1, Lt(jg) USN
Veitch, Edward W / assoc res engr, Burroughs Res Div, Phila / ADEP / '24, Harv, 4, -
Waite, John H, Jr / prgmr, Rem Rand, Phila / AEMPS, foreign comp & auto-coding / '17, U Va, 3, mathn
Wright, Stephen E / sr prgmr, Eckert-Mauchly Div, Phila / AP / '24, U Iowa, Harv U, 3, sr prgmr

DELAWARE: Hoerl, Arthur E / mathn-engr, Engrg Res Lab, Dupont, Wilmington / AMP, statistics, mach compn / '21, U So Cal, 2,mathn & statn

MARYLAND: Campaigne, Howard H / asst chf res, Natl Security Agcy, Baltimore / ADMP / '10, Nwn U, 7, mathn
Diehm, Ira Cortland / mathn, Navy Bur of Aeronautics / ABMP / '24, Franklin & Marshall, 4, mathn
Hearn, Saul D / chf, Ee Stat Sec, Bur Old-Age & Survivors Ins, Baltimore / ABP / '14, G Wash U, 3, statn
King, J E / jr engr, Davies Lab, Riverdale / ADEP, spec circ, VHF crystal oscillators & transmitters / '25, Iowa State, 0, prgmr
Whisler, Bertram F / mathn, Army Map Service, Wash, DC / AMP / -, State U Iowa, -, -
Young, David M / asst prof, U Md / AMP / '23, Harv (PhD'50), 2, prof math

WASHINGTON, D.C.: Dunn, Howard / asst chf, Prgm Rev & Anal Div, Plng Res Br, OCA / AMP, admn / '17, Geo Wash U / 12, asst res dir
Frye, Margaret Fulton / mathn, Naval Res Lab / AMP / '27, Geo Wash U, 5, mathn
Goor, Charles G / chf, stat sec, Intl Bank for Reconstruction & Dev / ABP / '12, Bklyn Col, -, statn
Heindish, Bernard / mathn, David Taylor Model Basin / EMP / '23, Geo Wash U, 3, mathn
Jenkins, Howard T / branch chf, Bur Census / AP / '99, U Md, 3, mach tabn
Kaplan, Sidney / res mathn, Ofc Comptr Army / ABMP / '12, Bklyn Col, 6, mathn
Skowron, Thaddeus / mathn, Army Map Serv / AMP / '08, Bklyn Polytech, 10, civ engr
Wood, Marshall K / chf, Plng Res Div, Mgt Analysis Service, Hq USAF / AP / '14, U Chic, 6, statn

VIRGINIA: Roberts, Alfred E, Jr / staff mathn, Engrg Res Assoc, Rem Rand, Arlington / AMP / '23, Yale U, 4, mathn
Schwab, John F / -, US Govt / ACDEMP / '98, MIT, 11, cartographer (res)
Shepard, David H / pres, Intelligent Mach Res Corp, Arlington / EMP, automatic reading / '23, U Mich, 8, engr

FLORIDA: Gephart, Landis S / res mathn, Statl Lab, U Fla / AMP / '17, Ohio State U, 4, mathn

OHIO: Berry, Harvey H / numerical analyst, Gen Elec. Cincinnati / ACDMP, astronomy, cybernetics / '27, U Ky, 2, mathn
Boughton, G A / suprv plant acctg, American Hard Rubber Co, Akron / ABP / '10, Akron U, -, acctnt
Buhl, Wm F / sr proced analyst, BF Goodrich Co, Akron / ABP / '10, Rutgers U, 6, dev of sys & proced
Gregg, John L / aerodynamicist, Lewis Flight Propul Lab, NACA, Cleveland / AP / '10, Ohio State U, 2, phys
House, Robert Wm / proj engr, OARAC, Compn Res Sec, Wri-Pat AFB / ACDEMP / '27, Ohio U, Ohio State U, 3, mathn & engr

Korn, K T / sr assoc, Edw A Berk & Assoc, Cleveland / ABMP, apln of theory to problems of mgt / '13, Hanseatische U, 0, mgt res dir
Little, Elbert P / chf, Compn Res Br, USAF, Wri-Pat AFB / ACDEMP, data handling / '12, Harv, 5, phys
Toman, Wm / dev engr, Goodyear Aircraft Corp, Akron / ACDEP / '16, Case Sch Apld Sci, 5, dev engr
Trefftz, Eleonore E / -, Dept Phys, Ohio State U, Columbus / AP, orgn compg grps / '20, U Leipzig, ½, phys (quantum mech)
Treon, Marion / techl asst, Thompson Products, Cleveland / ABMP / '25, Nwn U, 2, prgmr
Veirs, Stephen D / assoc res dir, F&R Lazarus & Co, Columbus / ABEP / '17, Ohio State (MS), 1, indl engr

INDIANA: Horner, John T / sr proj engr, Allison Div, Gen Motors, Indianapolis / AMP / '20, Purdue (BSME, MS), 3, supvr

ILLINOIS: Harvey, J Darrell / dir, Planning Dept, chmn, New Prod Ctee, Land-Air, Chi / ABSP, all corp contr phases for top mgt / '17, Cornell Col, Ia (BS'37), 2, mgt consltnt
Kowal, Chester B / res engr, Aldens, Chi / AEP, mail order / '13, Nwn U, 0, methods engr
Swanson, Leonard W / mathn, Apld Sci Dept, IBM, Chi / ABMPS / '13, U Minn, 2, -
Swigart, Wilson C / vp & prod mgr, AC Nielsen, Chi / ABP / '18, -, 17, exec
Wheeler, David J / visiting asst prof, U Ill, Urbana / DEMP / '27, Camb (England), 5, res

MICHIGAN: Carr, John W, III / res mathn, lectr in math, U Mich, Ann Arbor / AMP / '23, MIT, U Mich, Duke (BSEE, MSEE, PhD), 4, mathn
Dames, Ralph T / res asst, WRRC, Ypsilanti / AMP / '27, U Mich (MS&BS math), ½, mathn
Graves, Glenn W / res asst, WRRC, Ypsilanti / ADMP / '29, Mich State Col (MA math), -, mathn
Gurchinoff, George S / res asst, WRRC, Ypsilanti / CDMP / '27, U Mich, 1, log designer
Huskey, Harry D / techl dir, Compn Lab, Wayne U, Detroit / ADMP / '16, Ohio State U (PhD), 9, mathn
Murch, S Allan / -, -, Ann Arbor / AMP / '29, U Mich, 0, grad stud engrg
Neeb, Donna M / res asst, WRRC, Ypsilanti / P / '26, U Mich, 1, prgmr
Nims, Paul T / res engr, Chrysler Corp, Detroit / AMP / '16, U Mich, MIT, 6, elecl engr & res
Razgunas, Leo / res asst, WRRC, Ypsilanti / AMP / '26, U Mich (MS), ½, mathn-statn
Wyman, Irma M / res assoc, WRRC, Ypsilanti / ADMP / '28, Col Engrg U Mich (BSE math), 4, prgmr

MINNESOTA: Linderen, Harold A / phys, Engrg Res Assoc, Rem Rand, St Paul / EMP / '28, U Minn, 1, phys
Livermore, Robert / mgr, Tab Div, Nwn Natl Life Ins Co, Minnpls / ABP / '11, -, 1,-

Pestal, Charles F / assoc acty, Nwn Natl Life Ins Co, Minnpls / ABP / '13, -, 1, acty

MISSOURI: Rasche, David / proprietor, -, St Louis / ABCDEMP, comp log, stor sys / '24, Wash U, 2, meth engr

TEXAS: Clerc, R. J / sr res chem, Shell Oil Co, Houston / AEMP / '22, U Pgh, 1, res chem

TENNESSEE: Witt, Edward C / mathn, Carbide & Carbon Chem Corp, Oak Ridge / AMP / '24, U Va, 3, -

Knaplund, Paul W / mathn, IBM, Dallas / AMP / '28, Harv (BA), U Wis (MA), 4, mach mathn
Wood, H A / supvr mach compn, Chance Vought Aircraft, Dallas / AMP / '12, MIT (BS'34, PhD'38), 4, aeronl engrg compns

COLORADO: Wall, Francis Joseph / statn, Dow Chemical Co, Denver / ADMP, statn / '27, Sul Ross State Col, 3, -

NEW MEXICO: Jackson, John B / staff, Los Alamos Sci Lab, Los Alamos / ACDMP / '24, U Colo, 3, -
Metropolis, Nicholas / grp leader, Los Alamos Sci Lab, Los Alamos / ACDMP, theo phys / '15, U Chi, 9, phys
Schutzberger, Henry / supvr, Mathl Serv Div, Sandia Corp, Albuquerque / AMP / '13, U Ill, 5, mathn

CALIFORNIA: Aller, James C / ofcr, NAMTC, Pt Mugu / AMP / '21, Harv (MA'49), ½, Navy
Brock, Paul / sr mathn, Consol Engrg Corp, Pasadena / AMP, coding / '23, NYU (PhD'51), 5, mathn
Causey, Robert L / mathn, NAMTC, Pt Mugu / ADMP / '27, U Ky, 1, mathn
Coltin, Shirley Serena / mathn, NAMTC, Pt Mugu / P, meteorology / '23, UCLA, 2, -
Eads, Philip G / tab suprv, Gladding McBean & Co, Glendale / AP, '15, U Cal, 12, -
Hayes, Robert Mayo / staff, Hughes Aircraft Co, Culver City / AMP / '26, UCLA, 4, mathn
McCormick, E M / -, Missile Evaln Lab, NBS, Corona / AP, missile data handlg & processing / '20, Kans State, 3, elecnc engr
McGee, Russell C / mathn, NAMTC, Pt Mugu / ADMP / '26, U Cal (Berkeley), 2, -, mathn
Mendelson, Myron J / apln engr, Comp Res Corp, Hawthorne / ABDMPS, compg sys des & apln / '25, UCLA, 3, apln engr
Miles, Walter B / mathl engr, Lockheed Aircraft Corp, Los Angeles / AP / '28, UCLA, 1, mathl engr
Oldfield, Bruce G / mathn, Civil Service, China Lake / AMP / '23, Harv, 5, mathn
Potter, Norman A, Jr / mathn, Raydac Comp Unit, NAMTC, Pt Mugu / '27, Cal State Poly Col, 2, -
Robinson, Leland P / dir, Comp Div, Consol Engrg Corp, Pasadena / '19, U of NH, Cal Tech, 1, elecnc engr
Rock, Sibyl M, Miss / actg mgr, Apln Serv, Consol Engrg Corp, Pasadena / AMPS / -, UCLA, 1, -
Ross, Stanley / -, -, Stanford / ACDEMP / '32, Stanford U, -, grad stud
Schultheis, Herman J / des engr, Librascope, Glendale / ACDEMP / '00, Cal Tech, 4, -
Shiowitz, Marc / staff, Hughes Aircraft, Culver City / ABDP, log des / '25, CCNY, 3, apln analyst
Sinnette, John T, Jr / staff consltnt, USN Ordn Test Sta, Pasadena / AP / '09, Cal Tech, -, phys
Ware, Willis H / engr, Rand Corp, Santa Monica / ACDEMP / '20, Princeton U, 7, -
Warshawsky, Curtis B / sr mech engr, Hycon Mfg Co, Los Angeles / ADEMP / '17, Columbia U, UCLA, West Coast U, 10, proj engr
Wimberley, C M / mathn, NAMTC, Pt Mugu / MP, IBM compg mach, log des / '27, UCLA, 3, mathn

CANADA: Gellman, Harvard S / hd, Compg Sec, McLennan Lab, U Tor, Toronto / AMP / '24, U Tor, 5, mathn

<u>Correction</u>: In "Who's Who: Programming", January, 1953 issue, p 11, line 2 from bottom, replace "Gerhard, Walter" by "Walter, Gerhard".

BOOKS AND OTHER PUBLICATIONS
(List 3: COMPUTERS AND AUTOMATION, vol. 2, no. 3, April, 1953)

This is a list of books, articles, periodicals, and other publications which have a significant relation to the computing machinery field and which have come to our attention. The main purpose of this list is to report the existence of information. If you write to a publisher or issuer, we would appreciate your mentioning the listing in COMPUTERS AND AUTOMATION.

We shall be glad to report other information in future lists, if a review copy is sent to COMPUTERS AND AUTOMATION.

The general plan of each entry is: author or editor / title / publisher or issuer/ date, publication process, number of pages, price or its equivalent / a few comments. It is not planned to repeat entries in later issues of COMPUTERS AND AUTOMATION except where corrections or changes are involved.

1. Association for Computing Machinery / Proceedings of the Association for Computing Machinery, Meeting at Pittsburgh, Pa., May 1952 / Association for Computing Machinery, c/o Mr. R.V.D. Campbell, Treasurer, 511 No. Broad St., Philadelphia 23, Pa. / 1952, photooffset, 305 pp, $4

   Contains the transcript of 50 papers by many authors given at the May, 1952 meeting of the Association for Computing Machinery covering topics such as history of computing machinery, descriptions of individual computers, logical design, programming, circuitry, magnetic memory, etc.

2. Association for Computing Machinery / Proceedings of the Association for Computing Machinery, Meeting at Toronto, Ont., Sept. 1952 / Association for Computing Machinery, c/o Mr. R.V.D. Campbell, Treasurer, 511 No. Broad St., Philadelphia 23, Pa. / 1953, photooffset, 160 pp, $3

   Contains the transcript of 35 papers by many authors given at the Toronto meeting of the Association for Computing Machinery, Sept., 1952. Topics covered include numerical analysis, logical design, programming, and many other subjects.

3. Brasie, James W., Herbert F. Mitchell, and others / "Electronics Forum", pp.53-78, in Proceedings of the 13th Annual Conference, 1952 / Insurance Accountants Association, address not stated / Oct., 1952, printed, 132 pp, price not stated

   Gives a detailed description of the application of Univac to fire insurance, including several full page charts and tables.

4. Cooper, W.W., A. Henderson, and A. Charnes / An Introduction to Linear Programming / John Wiley & Sons, 440 4th Ave., New York 16, N.Y. / 1953, photooffset, 74 pp, $2

   Linear programming deals with the problem of what is the best possible (or optimal) procedure or programming under a given set of conditions; for example, optimal allocation of labor under given conditions of availability, wages, production problems, etc., is a problem in linear programming. The book has two parts, a general introduction and a mathematical development. A minimum background is assumed for the second part. The methods finally arrived at are adapted to hand or machine calculations. A bibliography is given.

5. Engel, Leonard / "Electronic Calculators: Brainless but Bright" pp. 84-90 in Harper's Magazine / Harper & Bros., 49 E. 33 St., New York 16, N.Y./ April, 1953, printed, 112 pp, 50¢

The author discusses the thesis that electronic computers can displace human minds, and the limits of automatic computers. Among other things he asserts that "a great branch of mathematics, algebra, is closed to" automatic computers, a statement which has already been disproved.

6. Institute of Applied Logic, staff of and contributors to / The Journal of Computing Systems, vol. 1, no. 2 / Institute of Applied Logic, 45 Water St., St. Paul 1, Minn / Jan. 1953, photooffset, pp. 57-110, $5 a year

This second issue, Jan. 1953, contains four technical papers dealing with: polynomials in a "field of integers modulo p"; "a universal decision element" "computing machinery foundations"; "cofinally concentrated directed systems".

7. Institute of Radio Engineers' Professional Group on Electronic Computers / Transactions of the IRE Professional Group on Electronic Computers, vol. EC-2, no. 1 / Institute of Radio Engineers, 1 E. 79 St., New York 21, N.Y./ March, 1953, printed, 16 pp, $2.10 each issue (to non-members)

This issue contains two articles, entitled "Dynamic Circuit Techniques Used in Seac and Dyseac" and "Symbolic Programming". The latter article, by N. Rochester, develops the idea that programs for automatic calculators can be written with symbolic instead of actual addresses in a way which relieves the programmer of considerable clerical work.

8. International Business Machines Corp. / Principles of Operation - Type 701 and Associated Equipment / International Business Machines Corp. / 1953, printed (Form 22-6042-0), 103 pp., perhaps free

Contains in Part I a description of the characteristics of IBM's new electronic data processing machines types 701, 706, 711, etc. and in Part II a discussion of programming and examples.

9. Kubanoff, Jack H / "Timothy, a Robot Electronic Turtle" pp. 35-38, 150-153, in Radio & Television News / Ziff-Davis Publishing Co., 366 Madison Ave., New York 17, N.Y. / April, 1953, printed, 162 pp, 35¢

Gives description and details for making an electronic "turtle". The robot can "see", interpret information, search for "food", memorize, and learn.

10. National Machine Accountants Association / The Hopper / National Machine Accountants Association, 35 E. Wacker Drive, Chicago 1, Ill. / monthly except Aug., photooffset, about 20 pp per issue, $2.50 a year

The February 1953 issue contains three articles on problemsof office efficiency and administration: "How to start a Standard Cost System" "How to Prepare Machine Procedure", "Advancements in Office Administration"; and several pages of personal news of chapters.

11. National Machine Accountants Association, New York Chapter / The Machine Accountant / National Machine Accountants Association, New York Chapter, Box 248, Murray Hill P.O., New York 16 / six times a year, photooffset, about 18 pp., free to members

The Nov-Dec. 1952 issue contains articles as follows: "Human Engineering — Our Future", "The Auditor looks at the Tabulating Department", "Remington Rand Introduces", "Machine Calculated Payroll". The magazine tends to concentrate on punch card machinery.

12. Rossheim, Robert J. and Nelson M. Blachman / A Survey of High Speed Printers for Digital-Computer Output / Mathematical Sciences Division, Office of Naval Research, Washington 25, D.C. / Aug. 1952, photooffset, 18 pp, perhaps free

Four pages are devoted to description of a number of mechanical, electrical, and electronic printers, and some discussion of printer input and typography. The rest of the report consists of pictures of machines, drawings, and samples of output.

ADVERTISING -- April, 1953

The purpose of COMPUTERS AND AUTOMATION is to be factual, useful, and understandable. For this purpose the kind of advertising we desire to publish is the kind that answers questions, such as: What are your products? What are your services? And for each product: What is it called? What does it do? How well does it work? What are its main specifications? Adjectives that express opinion are not desired. We reserve the right not to accept advertising that does not meet our standards.

Every advertisement in this issue, we believe, is factual and objective. For these reasons, we think that the advertising is likely to be worth reading. So far as we can tell, the statements made are reasonable, informative, and worth considering.

Following is the index to advertisements:

Advertiser	CA No.	Subject	Page
Alden Products Co.	52	Computer Components	32
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"	44	Back Copies	33
Engineering Research Associates Div.	51	ERA 1103 Automatic Computer	36
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George A. Philbrick Researches, Inc.	49	An Operational Amplifier	41
Reeves Instrument Co.	50	Reac Computing Equipment	38
Remington Rand, Inc.	51	ERA 1103 Automatic Computer	36

READER'S INQUIRY CARDS

Suppose you wanted to find out more information about something referred to in one of the advertisements in COMPUTERS AND AUTOMATION -- suppose you wondered what an operational amplifier was — suppose you wondered if you could use a certain small magnetic core memory — suppose ...

What would be the easiest, most convenient way for you to find out?

Thinking about the answer to that question, we have adopted "Reader's Inquiry Cards". One of them is bound in with this issue. We hope it will be a convenience to you.

The CA numbers on the card refer to the CA numbers shown in the index to advertisements.

Edmund C. Berkeley and Associates
Publishers of COMPUTERS AND AUTOMATION

BACK COPIES OF COMPUTERS AND AUTOMATION,
FORMERLY THE COMPUTING MACHINERY FIELD

C 6: March, 1953, vol. 2, no. 2, title "Computers and Automation", photooffset, 44 pp:
Reference Information: "List of Automatic Computers" (76 entries)
"Who's Who: Business" (about 130 entries)
"Roster of Organizations" (26 entries)
"Glossary - A,B" (24 entries)
Articles: "Gypsy, Model VI, Claude Shannon, Nimwit, and the Mouse", "Water and Computers", "The Concept of Automation", "The ERA 1103 Automatic Computer". ...$1.25,*

C 5: Jan., 1953, vol. 2, no. 1, title "The Computing Machinery Field", photooffset, 48 pp:
Reference Information: "Roster of Organizations" (64 entries)
"Who's Who: Programming" (c. 310 entries)
"Books and Other Publications" (5 entries)
Articles: "Brains, Electronic and Otherwise", "What Computers Do", "The Parameters of a Business Problem in Reading", "Automatic Computers on Election Night". ...$1.25,*

C 4: Oct., 1952, vol. 1, no. 4, title "The Computing Machinery Field", photooffset, 40 pp:
Reference Information: "Roster of Organizations in the Field of Computing Machinery" (c. 160 entries);
"Books and Other Publications" (15 entries)
Articles: "Communication and Control in the Computing Machinery Field", "The Parameters of Business Problems". ...$1.25,*

Earlier: Vol. 1, no. 1 (Sept. 1951), vol. 1, no. 2 (Feb. 1952), and vol. 1, no.3 (July 1952). Title: "Roster of Organizations in the Field of Automatic Computing Machinery". Contents: that only. Produced by ditto process. Out of date, and out of print.

*A subscription may be specified to begin with this issue. Rate, $4.50 a year in the United States and Canada, $5.50 elsewhere.

(Use This Coupon, or Copy It)

Edmund C. Berkeley and Associates, 36 West 11 St., S7, New York 11, N. Y.

1. ☐ Please send me the back copies circled:

C6 C5 C4

2. ☐ I subscribe to COMPUTERS AND AUTOMATION for _____ year. Please start my subscription with the issue of __________.

I enclose $_________ in full payment.

Name and address ______________________________

GENERAL CERAMICS

FERRAMIC CORES
FOR DIGITAL COMPUTERS

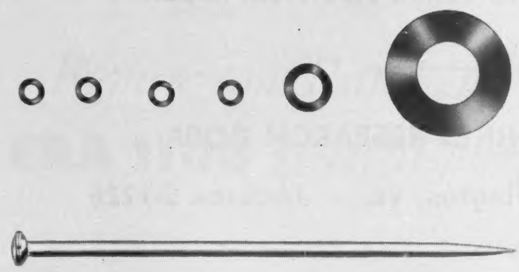

ILLUSTRATION SHOWS SIZE COMPARED
TO ORDINARY STRAIGHT PIN

featuring:

FAST RESPONSE
HIGH EFFICIENCY
HIGH VOLUME RESISTIVITY
LOW LOSS FACTOR

These new computer cores are molded of Ferramic MF 1118, a soft magnetic material featuring square hysteresis loops, high volume resistivity and a low loss factor. High efficiency performance is maintained at both high and low frequencies. Response time of Ferramic MF 1118 is about forty times faster than that of other magnetic materials; the new cores have a switching time of less than one microsecond.

Ferramic MF 1118 Magnetic properties include:

Initial Permeability	— 43
Maximum Permeability	— 700
Saturation Flux Density	— 2350 Gauss
Residual Magnetism	— 2130 Gauss
Coercive Force	— 1.5 Oersted
$\frac{\text{Residual Magnetism}}{\text{Saturation Flux Density}}$	— .91

As Ferramic is a ferro-spinel having high internal resistance, it is formed in solid sections without the necessity of lamination for high frequency application. The properties are stable and not affected by rough handling or ageing.

Core sizes available are as follows:

SMALL	.090 O.D.,	.060 I.D.,	.030 THICK	(approx.)
MEDIUM	.230 O.D.,	.120 I.D.,	.060 THICK	(approx.)
LARGE	.375 O.D.,	.187 I.D.,	.125 THICK	(approx.)

Complete data on these new Ferramic MF 1118 Cores will be supplied promptly on request to:

General CERAMICS AND STEATITE CORP.
Telephone: Perth Amboy 4-5100
GENERAL OFFICES and PLANT: KEASBEY, NEW JERSEY

MAKERS OF STEATITE, TITANATES, ZIRCON PORCELAIN, FERRAMICS, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE

Which of these books will help you most?

CHECK THE ONES YOU WANT AND

FLUX LINKAGES AND ELECTROMAGNETIC INDUCTION

By L. V. Bewley

The author presents here an important addition to electrical knowledge. He makes clear the reasons for common misinterpretations of Faraday's law and the elements that must be considered in induced voltage problems. He derives a general equation for the induced voltage in a circuit of any shape, moving and changing its configuration in any arbitrary fashion in a variable magnetic field of any distribution; gives general criteria for determining the way in which voltages are induced, and shows how to solve, in a simple, straightforward way, many problems heretofore considered paradoxes in electrical design work, testing and research. $3.50

NUMERICAL METHODS OF ANALYSIS IN ENGINEERING

By L. E. Grinter and others

In this book Shaw, Southwell, Grinter and other outstanding men discuss the results of research on the development and use of the Hardy Cross method of successive corrections. Both the mathematical and the physical points of view are presented, with examples of numerical solutions for Laplace's equation, thermal systems, elastic bodies and a wide variety of other mathematical and engineering problems. $5.80

ELECTRIC RESISTANCE STRAIN GAUGES

By W. B. Dobie and P. C. G. Isaac

This comprehensive guide to an important modern test tool includes the basic mathematical and electronic theory involved, the difficulties in its use, and methods for overcoming those difficulties. Chapters deal with gauge characteristics, determination of static strains, stress analysis, elementary electronics, electronic bridge circuits, problems in measuring dynamic strain, applications of strain gauges and brittle lacquer method of stress estimation. $4.00

MICRO-WAVE MEASUREMENTS

By H. M. Barlow and A. L. Cullen

This inclusive, up-to-date reference on the theory and techniques of high frequency measurements includes useful data on typical measurements and gives special attention to the effect of discontinuities and disturbances in the propagation of guided waves. Chapters discuss fundamental characteristics of guided waves, transformation of wave impedance, cavity resonators, measurement of wavelength and frequency, standing-wave measurements, matching and transmission systems, measurement of power, attenuation and Q-factor, electrical properties of materials, and receiver, transmitter and aerial measurements. The novel treatment of some of the problems of cavity resonators, probe reflectors and wave-guide transmission characteristics will be particularly valuable. $6.75

You'll be interested in

THE EXPANSION OF THE UNIVERSE

by Paul Couderc

This book gives you the background in clear, understandable terms of the new theory just announced by Einstein. It is the prize-winning summary of what is known about space and the bodies in it, the theories deduced from this knowledge, the weaknesses in those theories and possible ways out of these difficulties. The great theories of our times—Eddington's, Einstein's, de Sitter's, etc.—are clearly set forth in this truly brilliant study. Now available in English for the first time. $6.00

SEE THEM ON APPROVAL

Write to our Technical Book Department for copies on 10-day approval. You can return any book with which you are not fully satisfied.

The Macmillan Company

60 FIFTH AVENUE, NEW YORK 11, N.Y.

Memorandum from
Edmund C. Berkeley and Associates
Publishers of COMPUTERS AND AUTOMATION
36 West 11 St., New York 11, N.Y.

COMPUTERS AND AUTOMATION -- ADVERTISING

1. What is "COMPUTERS AND AUTOMATION"? It is a magazine published monthly, except June and August, containing articles, reference information, and advertising, related to computing machinery, robots, automatic controllers, cybernetics, automation, etc. The April issue is a sample. One important piece of reference information published is the "Roster of Organizations in the Field of Computers and Automation". The basic subscription rate is $4.50 a year in the United States and Canada. Single copies are $1.25. The magazine was called THE COMPUTING MACHINERY FIELD until the March issue; it was a quarterly from Oct. 1, 1952 to Dec. 31, and a bimonthly from Jan. 1, 1953 to Feb. 28.

2. Who are the logical readers? The logical readers of COMPUTERS AND AUTOMATION are the members of the Association for Computing Machinery, numbering some 1300, and probably another 2000 persons who are concerned with the field of computers and automation, etc. Many people are entering this field all the time. These include a great number of people who will make recommendations to their organizations about purchasing computing machinery and similar machinery. We have been carefully gathering the names and addresses of these people for some time and believe we can reach them. The print order for the April issue is 1300 copies, same as for the January issue. The paid circulation on Mar. 31, 1953 was just over 700.

3. Information about products and services. The listings in the "Roster of Organizations" contain very brief statements about the chief products and services of each organization. It is a help to the reader of COMPUTERS AND AUTOMATION to give a good deal more information. It seems that the best and most reasonable way to provide this added information is through advertising, of a strictly factual character, printed in the magazine.

4. What type of advertising does COMPUTERS AND AUTOMATION take? The purpose of the magazine is to be factual and to the point. For this purpose the kind of advertising wanted is the kind that answers questions factually. See the introduction to the advertising in the April issue, and the published advertisements as samples. We recommend, for the audience that we reach, that advertising be factual, useful, interesting, understandable, and new from issue to issue. We have had a number of comments expressing satisfaction with our style of advertising.

5. What is the cost of advertising? The next two issues of COMPUTERS AND AUTOMATION will be in May and July, 1953. They will be on pages 8½" by 11" and will be produced by photooffset. If possible, the company advertising should produce final copy, which should be actual size, and may include typing, writing, line drawings, printing, screened half tones, etc. -- any copy that may be photooffset without further preparation. If inconvenient to produce this, we will take rough copy and arrange with the printer to prepare it; there will be small additional charges in this event. Display advertising will be sold in units of full pages (ad size 7" by 10", basic rate $80) and horizontal half pages (ad size 7" by 5", basic rate $44); back cover, $150; inside back cover $100. Classified advertising will be sold by the word (30 cents a word), with a minimum of ten words. The following discounts will apply to display advertising excluding cover space: 20% for a company with less than 100 employees and a publisher of books; 40% for a company of less than 20 employees; 2% for payment before the closing dates April 28 for the May issue and June 26 for the July issue.

MONROBOT Electronic Calculator

for business and science . . .

The ten basic operations performed by the Monrobot Electronic Calculator and their corresponding speeds are given below. These operating speeds include storage access time.

	OPERATIONS PER MINUTE
Addition	450
Subtraction	450
Multiplication	100
Division	100
Comparison	450
Modification	450
Stop	–
Print	10 digits per second
Print Stop	10 digits per second
Read Tape	10 characters per second

The Keyboard unit

Specially designed for compactness and convenience of operation, the Monrobot consists of only three units: Keyboard Input unit, Computer unit, the size of a standard office desk, Printer Input-Output unit.

MONROBOT CORPORATION Morris Plains, New Jersey